

Open Research Online

The Open University's repository of research publications and other research outputs

Is there ice on Mars?

Other

How to cite:

Foley, Lori-Ann (2020). Is there ice on Mars? Postgraduate Research Poster Competition, The Open University.

For guidance on citations see [FAQs](#).

© [not recorded]



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Poster

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

Is there ice on Mars?

Lori-Ann Foley, Prof. Stephen Lewis, Dr Matt Balme

Contact: lori-ann.foley@open.ac.uk

Background

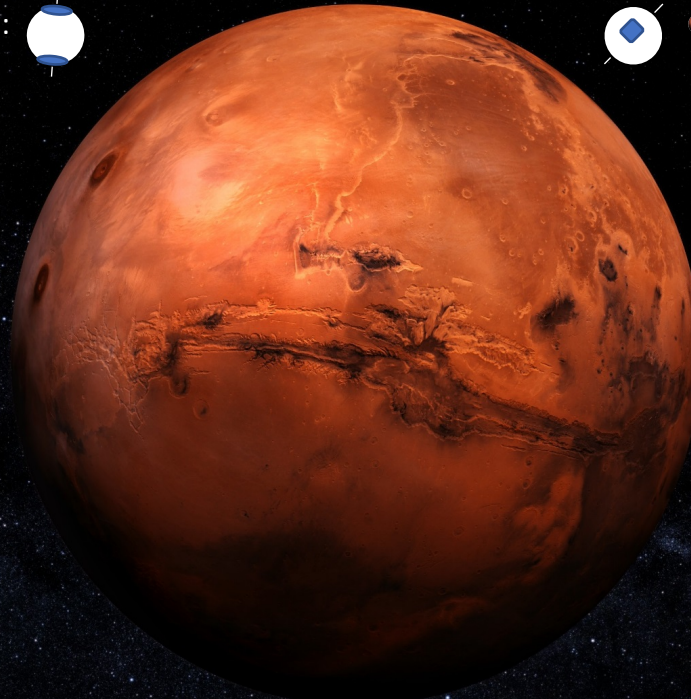
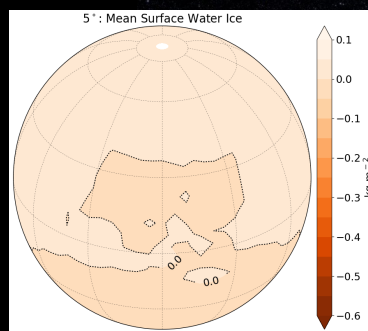
- The water cycle is a crucial element of the Martian climate, past and present, and has significant effects on the geology.^{1, 2, 3, 4}
- Understanding the water cycle involves understanding how the climate changes due to changes in orbital parameters, such as obliquity - the angle between the rotational and orbital axes.^{3, 5}
- Climate model simulations using a representative set of values of obliquity can provide insight into the processes which control the behaviour of the water cycle and surface ice.^{6, 7}

My research

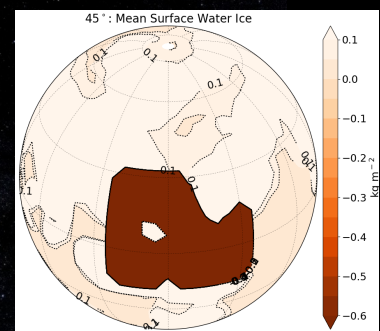
- Changes in obliquity are a major driver of climate change and have a significant influence on the distribution of solar heating across the planet's surface.^{3, 7}
- Simulations with obliquities of 5° – 55° were run using the LMD-UK Mars Global Climate Model⁸, with ice sources at one pole, both poles or in the tropics.
- Output focused on the movement of water vapour and surface ice around the planet during the year.

Results and discussion

- 5° obliquity; ice source at both poles: when the planet is nearly upright, the poles receive very little solar heating and so only small amounts of water vapour sublimate from the ice at both poles. There is little water vapour in the atmosphere to be transported around the planet so little change in the surface ice.

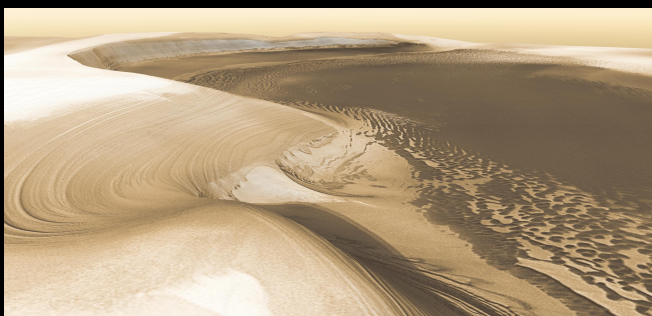
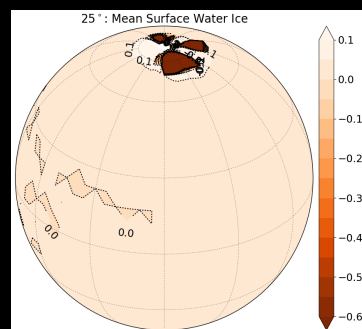


- 45° obliquity; ice source in tropics: with the planet at an even greater tilt, the poles receive more solar heating and most of their ice caps sublimate. The water vapour condenses in the much cooler tropics, where equatorial ice caps form on the higher ground.^{9, 10}



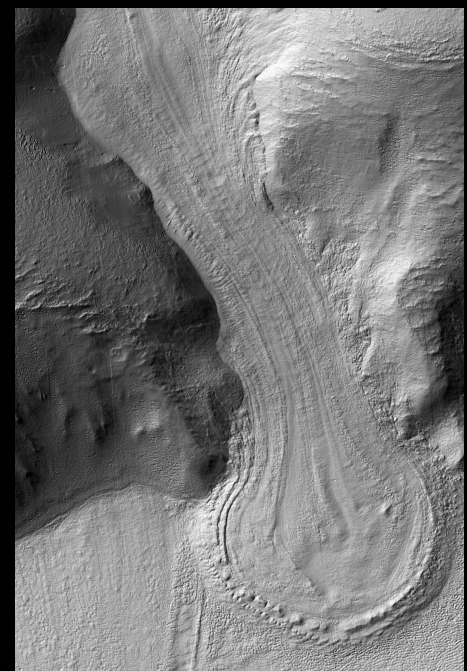
The three graphics show output from the climate model with areas of sublimation (dark) and deposition (light) of surface ice, averaged over the year.

- 25° obliquity; ice source at north pole: with the planet more tilted, the north pole receives more solar heating and more water vapour sublimates into the atmosphere. It is transported to the equator and southern hemisphere. Some condenses at the south pole; the rest returns to condense on the north polar ice cap during the winter.



Left: The north polar ice cap is a source of water vapour in the summer and a sink for surface ice deposited in the winter during epochs of low and medium obliquity (THEMIS camera on NASA's Mars Odyssey Orbiter).

Right: The Protonilus Mensae glacier is one of many glaciers found in the tropics, formed during epochs of high obliquity (HiRISE camera on NASA's Mars Reconnaissance Orbiter).



Future work

- I will use the LMD Mars Mesoscale Model, incorporating the data above, to study the relationship between the local mesoscale water cycle and the ice-rich deposits found in and around Lyot Crater, and how they have changed over time.

References: 1. Read & Lewis, *The Martian Climate Revisited*, **2004**. 2. Montmessin et al, in *Atmos. Clim. Mars*, **2017**. 3. Laskar et al, *Icarus* 170(343), **2004**. 4. Dickson et al, *Geophys. Res. Lett.* 36(2), **2009**. 5. Nerozzi & Holt, *Geophys. Res. Lett.*, GL082114, **2019**. 6. Jakosky et al, *Icarus* 102(286), **1993**. 7. Jakosky et al, *J. Geophys. Res.*, 100(1579), **1995**. 8. Forget et al, *J. Geophys. Res. Planets*, 104 (24155), **1999**. 9. Jakosky & Carr, *Nature*, 315(559), **1985**. 10. Forget et al, *Science*, 311(368), **2006**.